

Sector-Based Pollution Prevention: Toxic Reductions through Energy Efficiency and Conservation Among Industrial Boilers

A Presentation to the
Binational Toxic Strategy
Dioxin Workgroup

Windsor, ON
May 14, 2003

Presented by:



The Delta Institute
Chicago, Illinois

Project Hypothesis

Energy efficiency improvements offer significant opportunities to reduce energy consumption as well as emissions of certain toxic air emissions.

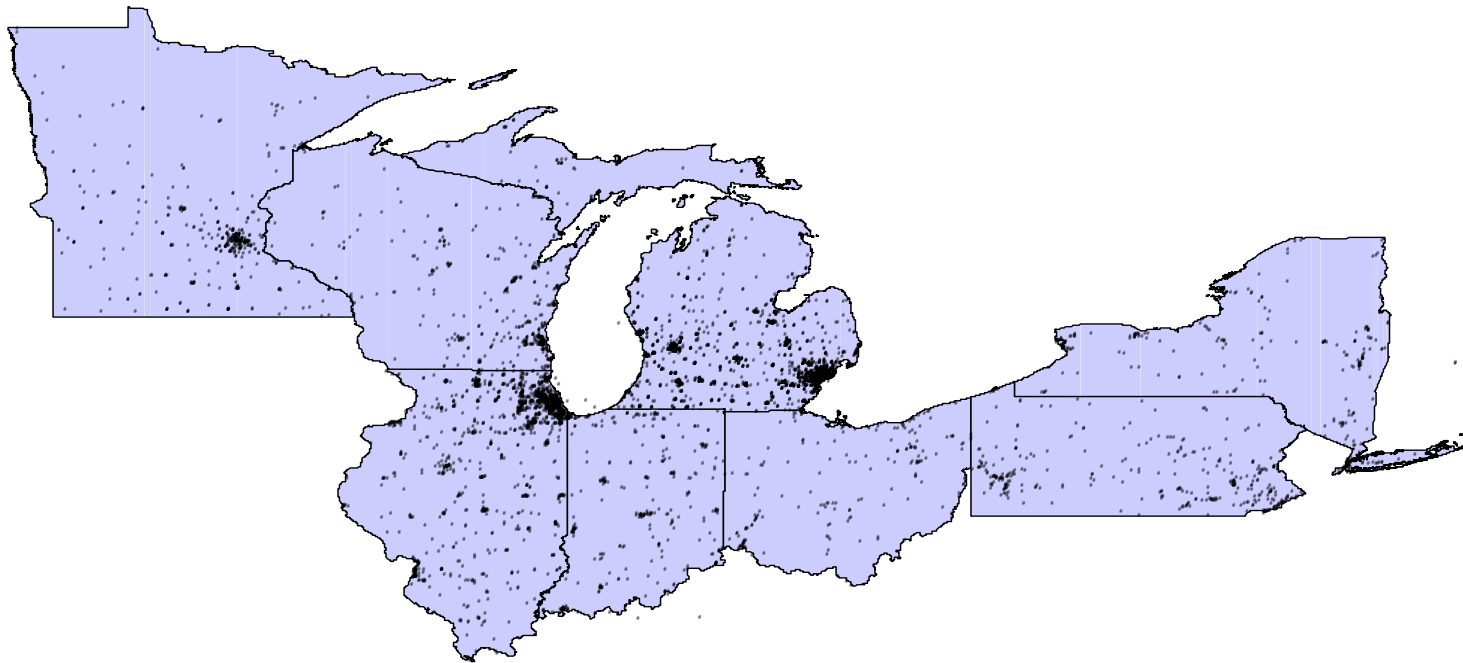


Industrial Boilers as an Aggregated Source

- Manufacturing industrial sources produce over 245 billion kilowatt hours of electrical energy each year (6% of U.S. total).
- Industrial boilers are used in over 800 industrial/commercial/institutional sectors- 50% of those boilers are used by 17 sectors.
- Over 51,000 industrial boilers and heaters in the U.S.- over 20,000 are located in the Great Lakes region



Great Lakes Stated Industrial Boiler Facility Locations



Regulatory Framework

- Title V
- PSD/NSR
- Acid Rain Program
- MACT
 - Industrial/commercial/institutional boilers and process heaters located at major sources



Aggregation Analysis

DATA

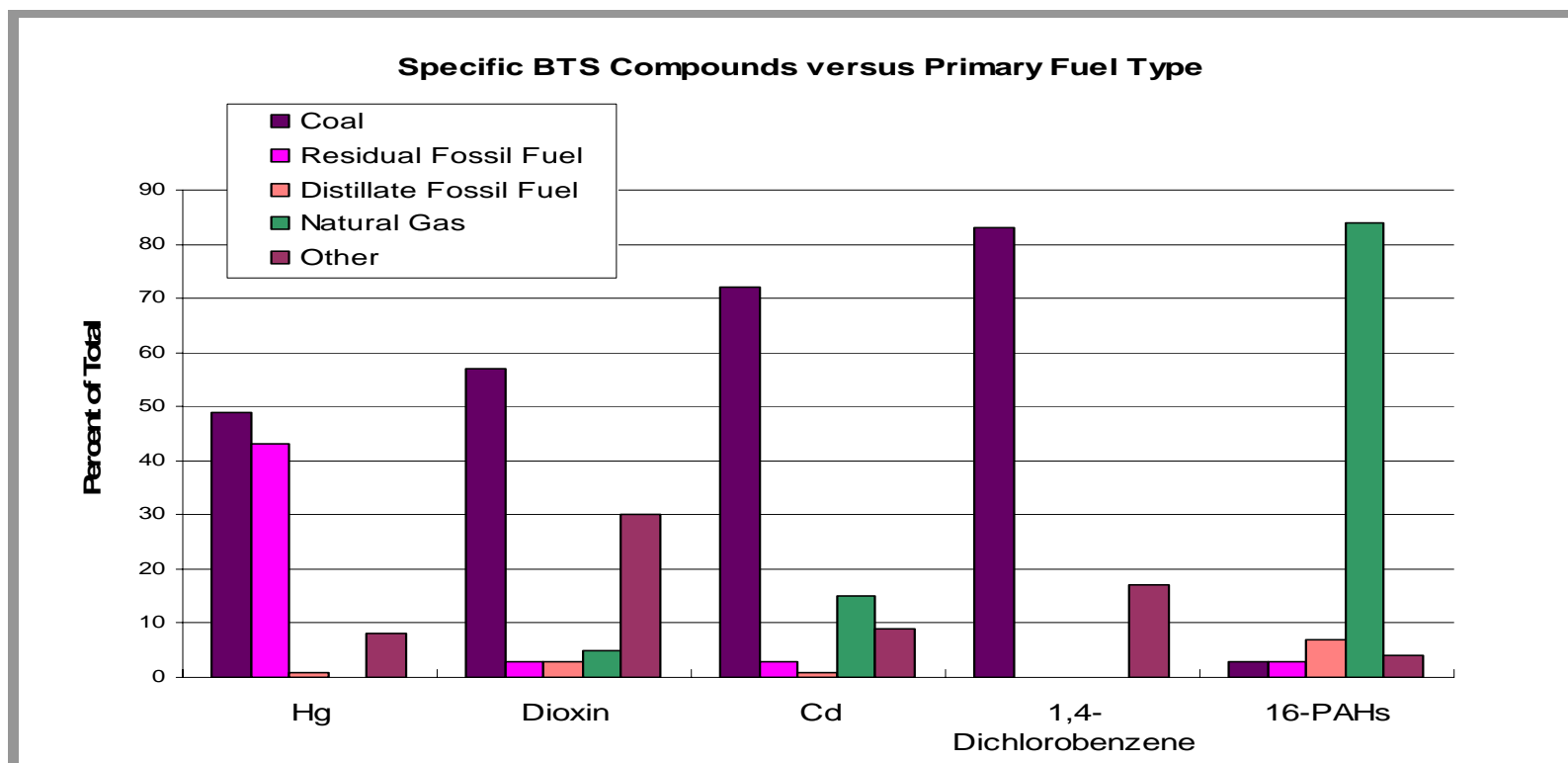
- U.S. EPA Emissions Test, Population, and Materials Analysis Database dated 12/14/99 and update state inventories
- Emission factors developed for Industrial/Commercial/Institutional Boiler MACT
- Energy efficiency improvement recommendations from Delta Institute boiler assessments

METHODOLOGY

- Analyzed eight Great Lakes states- IL, IN, MI, MN, NY, OH, PA, WI
- Detailed analysis on IL, MI, OH, and WI
- Segregated boilers by fuel type
- Evaluated emissions based on primary fuel
- Assessed emissions reductions from energy efficiency improvements



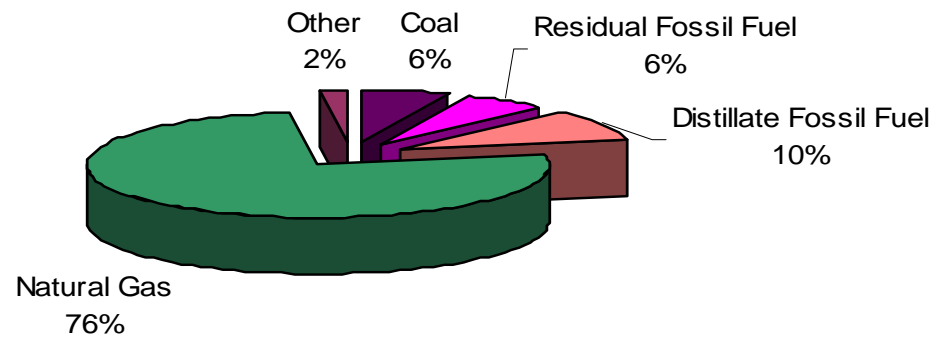
Aggregation Analysis: Binational Toxic Strategy Emissions



Aggregation Analysis: Inventory

Great Lakes States Industrial Boiler Primary Fuel Summary

Total Number of Industrial Boilers: approx. 20,000



What is the significance of this aggregated source?

Compound	U.S. Emissions from all sources	U.S. Aggregated Industrial Boiler Emissions	Percent Total of U.S. Emissions from All Sources
Mercury	125 tons/yr	12 tons/yr	10%
Dioxin	2.2 to 90 lbs/yr	10.7 lbs/yr	0 to 12%
Cadmium	157 tons/yr	20 tons/yr	13%
1,4-Dichlorobenzene	10,900 tons/yr	4 tons/yr	<1%
16-PAHs	20,800 tons/yr	375 tons/yr	2%



Industrial Boiler Dioxin Emissions Compared to Statewide Emissions

State	Number of coal/wood fuel fired boilers	Number of industrial boilers in state database	Minimum emissions of dioxin (lbs/yr)	Maximum emissions of dioxin (lbs/yr)	Total reportable state emissions (TRI 2000)
Illinois	71/10	3,133	0.174	0.240	0.19
Michigan	94/19	1,197	0.179	0.276	1.12
Ohio	148/11	763	0.382	0.555	1.2
Wisconsin	50/116	1,683	0.448	0.577	0.298

Industrial sectors with largest number of coal fired units

Rank	Illinois	Wisconsin	Michigan	Ohio
1	Chemicals	Paper and allied products	Transportation equipment	Chemicals
2	Food	Academic institutions	Chemicals	Primary metals
3	Fabricated metals	Transportation equipment	Paper and allied products	Transportation equipment
4	Stone, clay, and glass	Medical facilities	Food	Food
5	Medical facilities	Social services	Justice, public order, and safety	Paper and allied products

The punchline.....

60% of the Dioxin emitted by industrial boilers in the eight Great Lakes states is from 12% (total coal and wood fired boilers) or approximately 2,400 boilers.



What is the significance of a 10% energy efficiency improvement?

10% energy efficiency improvement by coal and residual oil fired boilers would potentially reduce Dioxin emissions in the eight Great Lakes states by approximately 0.3 pounds per year



Estimated Toxic Emissions Reductions from Great Lake States Industrial Boilers Resulting from a 10% Energy Efficiency Improvement

Compound	Coal (lbs/yr)	Residual Fuel Oil (lbs/yr)	Distillate Fuel Oil (lbs/yr)	Natural Gas (lbs/yr)	Other Fuel (lbs/yr)	TOTAL (lbs/yr)
Approx. number of boilers	1,500	1,400	2,500	18,500	400	
Mercury	443	389	<0.01	NA	73	905
Dioxin	0.17	0.01	0.01	0.02	0.09	0.3
Cadmium	826	32	6	175	101	1,140
1,4- Dichlorobenzene	101	NA	NA	NA	21	122
16-PAHs	1,043	927	2,353	30,453	1,293	36,069

- (1) Emission factors not readily available.
- (2) CO₂ and NO_x reductions will occur; however, emission factors not developed at part of MACT program.



Estimated Criteria Pollutant Emissions Reductions from Great Lake States Industrial Boilers Resulting from a 10% Energy Efficiency Improvement

Compound	Coal (tons/yr)	Residual Fuel Oil (tons/yr)	Distillate Fuel Oil (tons/yr)	Natural Gas (tons/yr)	Other Fuel (tons/yr)	TOTAL (tons/yr)
Approx. number of Boilers	1,500	1,400	2,500	18,500	400	
PM	189,300	24,100	1,800	1,600	64,300	281,200
CO	11,500	1,700	6,700	6,669,100	98,900	6,787,900
SO₂	1,093,900	(1)	(1)	(1)	194,100	1,288,000
CO₂	1,100	600	900	3,000	(1)	5,600
NO_x	14,400	(2)	(2)	(2)	(2)	(2)

(1) Emission factors not readily available.

(2) CO₂ and NO_x reductions will occur; however, emission factors not developed at part of MACT program.

Energy Efficiency Opportunities

Category	Number of Recommendations	Average Capital Cost	Average Yearly Cost Saving	Average Efficiency Improvement
Start-up/Shut down procedures	4 (1)	\$0	\$1,500	<1%
Fuel management	9	\$77,000	\$133,800	0.8%
Water treatment	4	\$93,200	\$24,300	2%
Combustion air pre-heating	3 (1)	\$12,000 to \$75,000	\$146,700	2%
Controls	8	\$53,100	\$46,000	1.4%
Associated equipment	2	\$65,000	\$109,800	3%
Steam systems	6	\$21,300	\$313,900	9%

(1) Cost information provided for one recommendation.



How can energy efficiency improvements be promoted to industrial boiler owners?

Barriers

- Expertise
- Management
- Financial
- Environmental Regulations
- Talking-the-talk
- **GETTING TO SCALE**

Incentives

- Taxes
- Public Recognition
- Technical Assistance
- **FINANCING**



Next Steps....

Conduct a sub-regional industrial boiler energy efficiency outreach campaign to achieve meaningful reductions of toxic compounds.

- Target a sub-region with a concentration of coal and residual oil-fired boilers
- Align state/federal/private regional partners
- Identify technical assistance and incentives such as combustion expertise and financing
- Evaluate possible new incentives for financing energy efficiency and toxic reduction
- Develop standardized quantification and reporting methods for toxic reductions realized through energy efficiency measures.



Challenge Questions

- Could an industrial boilers outreach effort be aligned with other voluntary reductions initiatives?
- How best to quantify dioxin reductions?

Acknowledgements

The Delta Institute would like to thank the U.S. EPA Great Lakes National Program Office for funding this project.

We would like to acknowledge the facilities that participated in the assessments, CIBO, the Wisconsin DNR, and the Wisconsin Focus on Energy for their involvement.



Contact Information

Abigail Jarka, PE

The Delta Institute
52 West Jackson Boulevard
Suite 230
Chicago, Illinois 60604
312-554-0900
www.delta-institute.org

